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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/824,288	04/13/2004	Max Shtein	12992/90501	6049

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EXAMINER
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SUCH, MATTHEW W

ART UNIT	PAPER NUMBER
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2891

DATE MAILED: 04/19/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

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<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>	
	10/824,288	SHTEIN ET AL.	
	<b>Examiner</b>	<b>Art Unit</b>	
	Matthew W. Such	2891	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 13 April 2004.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-34 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-34 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 April 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                        | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)               | Paper No(s)/Mail Date. _____  |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>10 February 2006</u> , <u>7-26-04</u> , <u>4/4/05</u>                     | 6) <input type="checkbox"/> Other: _____                                    |

## DETAILED ACTION

### *Drawings*

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore the following features must be shown or the feature(s) canceled from the claim(s):

- i. wetting layer as recited in claims 14-16 and 29-30,
- ii. planarization layer as recited in claims 14-16 and 29-30,
- iii. electron-hole recombination zone over the second layer as recited in claims 31 and 32,
- iv. third layer as recited in claims 31 and 32,
- v. fourth layer as recited in claims 31 and 32.

No new matter should be entered.

2. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the

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renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

***Claim Rejections - 35 USC § 112***

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 4 and 5 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

5. Claims 4 and 5 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite in that it fails to point out what is included or excluded by the claim language. This claim is an omnibus type claim.

Basic geometry dictates the surface area to volume ratio can be expressed by:

$$\text{Ratio} = \frac{\text{Area}}{\text{Volume}}.$$

So by considering an arbitrary geometric shape, such as a cube, where the area is defined by:

$$\text{Area} = 6 \times \text{Length}^2.$$

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The cube volume is defined by:

$$Volume = Length^3.$$

Therefore, the surface area to volume ratio for the example cube is:

$$Ratio = \frac{6 \times Length^2}{Length^3} = \frac{6}{Length}.$$

While surface area to volume ratio is not limited to cubes, but applies to all arbitrary geometric shapes, the preceding ratio can never be a dimensionless quantity. By simply expressing any arbitrary shape and size in any arbitrary unit, the surface area to volume ratio can be set to any arbitrary value.

### ***Claim Rejections - 35 USC § 102***

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1-5, 8-11, 17-19, 23-26 and 33-34 are rejected under 35 U.S.C. 102(e) as being anticipated by Foust ('508).

8. Regarding claims 1-2, 8-11, 17-18, 23-26, and 33-34, Foust teaches a method for producing and optoelectronic device by depositing organic layers on a plastic substrate (Paragraphs 0016-0018) with an indium-tin-oxide (ITO) electrode (Paragraph 0024) by an

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organic vapor phase deposition (OVPD) method (Paragraphs 0007 and 0034). Organic compounds and other layers have some roughness wherein a first layer tends to adhere to itself, even at the atomic scale, inherently forming protrusions since Foust teaches the method as disclosed in the claims 1 and 17.

Foust teaches that an electron donor layer of copper phthalocyanine (CuPc) is deposited on ITO (Paragraph 0028). The CuPc layer adheres to itself as well the electrode on which it is deposited, rather than the substrate, since the electrode covers the substrate. An electron acceptor layer of buckminsterfullerene (C60) is deposited directly on CuPc (Paragraph 0029) and a second electrode is formed over the structure (Paragraphs 0030-0031 and 0035).

9. Regarding claims 3 and 19, Foust teaches the device may be deposited in reverse since the ITO electrode can form the cathode (Paragraph 0026).

10. In so far as claims 4 and 5 are definite, the surface area to volume ratio of the CuPc layer can be arbitrarily set to any value as shown above. Furthermore since Foust teaches the method as disclosed in claim 1, the surface area to volume ratio will inherently be within the claimed range.

11. In so far as definite, claims 1-2, 7, 9-13, 22, 25-28 and 33-34 are rejected under 35 U.S.C. 102(e) as being anticipated by Forrest ('445).

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C.

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102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention “by another,” or by an appropriate showing under 37 CFR 1.131.

12. Regarding claims 1-3, 7, 9-11, 17-19, 22, 25-26 and 33-34, Forrest teaches a method for forming an optoelectronic device wherein any of the organic layers can be deposited by organic vapor phase deposition (OVPD) on a plastic substrate (Col. 7, Lines 65-67; Col. 8, Lines 16-18; Col. 14, Lines 21-28; Fig. 1).

A first layer is an electron donor layer of CuPc (Col. 8, Lines 60-64) and a second layer is an electron acceptor layer of PTCBI (Col. 8, Lines 64-67; Col. 9, Lines 1-6) are deposited on a first electrode, and ITO electrode (Col. 8, Lines 11-12 and 16-18). The first electrode can be an anode, which tends to be very rough, and induce protrusions in the deposited first layer (Col. 13, Lines 58-60). A second electrode, a cathode, is deposited over the structure (Col. 9, Lines 24-43). The device may be deposited in reverse (Col. 3, Lines 34-49; Col. 10, Lines 53-56; Col. 13, Lines 16-18).

13. Regarding claims 12-13 and 27-28, Forrest teaches a BCP exciton blocking layer is formed between the second layer and a second electrode (Col. 9, Lines 7-23).

*Claim Rejections - 35 USC § 103*

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

15. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Foust ('508) in view of Forrest ('102).

Foust teaches the method of claim 1 wherein organic semiconductor molecules can be deposited by OVPD at low temperatures and pressures but does not teach specific conventional details such as the substrate temperature and chamber pressure (Foust Paragraph 0034).

Forrest teaches OVPD method for depositing organic semiconductor molecules into layers. It would have been obvious to one of ordinary skill in the art at the time the invention was made to deposit the organic layers of Foust by using a substrate temperature of 15 degrees Celsius and a pressure of 0.65 Torr as taught by Forrest in order to maintain surface integrity and quality of the layers (Forrest Col. 8, Lines 5-51). Furthermore, Foust teaches that it is desirable to maintain low processing temperatures during construction of the organic devices to maintain the integrity of the organic layers (Foust Paragraph 0038). It has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

16. Claims 7 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Foust ('508) in view of Forrest ('846).



Foust teaches the methods of claims 1 and 17 where first and second organic semiconductor layers of CuPc and C60, respectively, are formed to produce an optoelectronic device (Foust Paragraphs 0028-0029). Foust does not teach using the specific compound 3,4,9,10-perylenetetracarboxylic bis-benzimidazole (PTCBI) as an electron acceptor layer.

Forrest also teaches forming layers of CuPc and C60, or in the alternative CuPc and PTCBI, as an electron donor and electron acceptor layer, respectively (Paragraphs 0034, 0044-0045 and 0062-0065). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use PTCBI in place of C60 for an electron acceptor layer since the compounds are functional equivalents.

17. Claims 12-13 and 27-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Foust ('508) in view of Forrest ('846).

Foust teaches the methods of claims 2 and 18 where the optoelectronic device formed by first and second organic semiconductor layers functions as a photovoltaic or light emitting device (Foust Paragraphs 0005-0007). Foust teaches using a reflective top electrode material to reflect light either generated from the active region or capture additional light from an external source, increasing the efficiency of the device (Foust Paragraphs 0005-0008 and 0035). Furthermore, Foust teaches the use of phosphor particles in the device to convert sunlight wavelengths to wavelength which are more readily adsorbed by the organic active layers as well as to enhance light trapping (Foust Paragraph 0022). Foust does not teach additional alternative methods for enhancing the efficiency of the device.

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Forrest teaches depositing an exciton blocking layer of BCP material between the second layer and the second electrode (Forrest Paragraphs 0022-0030). It would have been obvious to one of ordinary skill in the art at the time the invention was made to add a BCP exciton blocking layer taught by Forrest to the methods taught by Foust in order to increase the photocurrent density of the photovoltaic device and improve efficiency (Forrest Paragraphs 0026-0030, 0051-0052 and 0062-0067; Figs. 1-2 and 5).

18. Claims 14-16 and 29-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Foust ('508) in view of Forrest ('846).

Foust teaches the methods of claims 1 and 17 wherein PEDOT/PSS material can be used as an organic semiconductor material in the device which can be deposited by OVPD (Foust Paragraphs 0027 and 0034). However, Foust does not teach using the PEDOT/PSS layer in tandem with the CuPc and C60 layers to form a device.

Forrest teaches using PEDOT/PSS layers on an the ITO electrode in order to planarize the surface and prevent shorting instances in the devices (Forrest Paragraph 0057). Although, Foust does not teach using a PEDOT/PSS layer as a planarization over the second organic semiconductor layer below the second electrode, Foust does teach minimization of shorting is desirable. Foust teaches methods where the devices are segmented into discrete elements in order to prevent short circuits in one area of the device from shorting the entire layer set (Foust Paragraph 0035). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to add a PEDOT/PSS layer as a planarizing layer over the ITO

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layer and under the second electrode in order to planarized the electrode surfaces and reduce instance of shorting in the devices.

19. Claims 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Foust ('508) in view of Forrest ('462).

Foust teaches the method of claim 17 wherein one layer of an organic region is an electron acceptor and another layer is an electron donor and that electron-hole pairs created by absorption of photons must be dissociated to generate a current (Foust Paragraph 0007). Foust is silent, however, regarding specifically describing methods to increase the dissociation of charges.

Forrest teaches methods for forming organic photovoltaic devices having an electron acceptor layer and electron donor layer wherein charge dissociation efficiency is related to active layer thickness and interfacial geometry (Forrest Paragraph 0020). Forrest further teaches that nanotextured materials having repeated interfaces or highly folded interfaces can offer improvement of charge collection (Forrest Paragraph 0022). The exciton diffusion length should be greater than the layer thickness, or protrusion diameter, to avoid electron-hole recombination (Forrest Paragraph 0020). The thickness should not be so large as to reduce the strength of dissociation-assisting electric fields, leaving an optimum range for the thickness, or protrusion diameter (Forrest Paragraph 0020).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to set the diameter of protrusions to be 1.5 to 3 times the exciton diffusion length to optimize the charge carrier dissociation efficiency by controlling the surface interface

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as described above. It has been held that where the general conditions of a claim are disclosed in prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233.

20. Claims 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Foust ('508) in view of Forrest ('846).

Foust teaches the methods of claims 1 and 17 where the optoelectronic device formed by first and second organic semiconductor layers functions as a photovoltaic or light emitting device (Foust Paragraphs 0005-0007). Foust teaches using a reflective top electrode material to reflect light either generated from the active region or capture additional light from an external source, increasing the efficiency of the device (Foust Paragraphs 0005-0008 and 0035). Furthermore, Foust teaches the use of phosphor particles in the device to convert sunlight wavelengths to wavelength which are more readily adsorbed by the organic active layers as well as to enhance light trapping (Foust Paragraph 0022). Foust does not teach additional alternative methods for enhancing the efficiency of the device.

Forrest teaches depositing a gold layer as an electron-hole recombination site over a second organic layer, such as PTCBI (Forrest Paragraphs 0062-0065; Fig. 1 and 2). This deposition is followed by a third and fourth layer between over the gold recombination zone and an electrode over the entire structure (Forrest Paragraphs 0023, 0062-0065; Fig. 1 and 2).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to add a gold electron-hole recombination layer and a third and fourth organic semiconductor layer over the second organic semiconductor as taught by Forrest to the methods

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taught by Foust. One would have been motivated to do so to increase the efficiency of the photovoltaic device by boosting photo voltage (Forrest Paragraphs 0023-0024 & 0063; Fig. 3).

### ***Conclusion***

21. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

Yamazaki ('284), Roman ('555), Thompson ('528), Psai ('738), Forrest ('055), Smalley ('251) and Bulovic ('092) each teach various configurations of organic-based light emitting devices and photovoltaics using common molecules such as CuPc, AlQ3, PEDOT/PSS, BCP, CBP,  $\alpha$ -NPD, MTDATA, fullerenes, and derivatives.

### ***Contact Information***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew W. Such whose telephone number is 571-272-8895. The examiner can normally be reached on Monday - Friday 8AM-5PM EST.

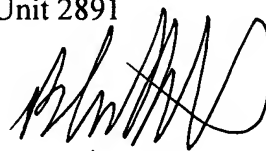
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bradley W. Baumeister can be reached on 571-272-1722. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MWS  
4/10/2006

Matthew W. Such  
Examiner  
Art Unit 2891



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